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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—SPECIAL CIRCULAR.

A. C. TRUE, Director.

FORESTRY IN NATURE STUDY.

ISSUED BY THE
OFFICE OF EXPERIMENT STATIONS
IN COOPERATION WITH THE
FOREST SERVICE.

[GIFFORD PINCHOT, FORESTER.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 1, 1909.

SIR: I have the honor to transmit herewith a manuscript prepared by the Forest Service for special distribution among teachers at the Alaska-Yukon-Pacific Exposition. In view of the large interests of the Northwest and of the whole country in forest conservation and in the methods of forest replacement, and the growing interest of public-school teachers in these matters, it seems desirable to present this tentative plan of elementary instruction in the subject to the attention of teachers for the purpose of drawing out their criticisms and suggestions with reference to it. With the understanding that the results of such suggestions shall be embodied in more permanent form in future bulletins by this Office, I therefore recommend the immediate publication of this manuscript as a special circular of this Office.

Respectfully,

A. C. TRUE,
Director.

Hon. W. M. HAYS,
Acting Secretary of Agriculture.

FORESTRY IN NATURE STUDY.

The development of forestry and nature study in this country has been practically contemporaneous. A generation ago little was known of either; to-day the one has come to occupy an important place in national life, the other an essential part in school life. Both, however, are still young in this country but growing rapidly, and are ever stretching out to new and wider fields—forestry, that all may realize its importance to the nation's welfare; nature study, in a constant search for suitable material to work upon. As a result of these tendencies forestry and tree study are every year becoming more prominent in nature-study courses, and very properly so, for they are preeminently adapted to such use.

Dr. Clifton F. Hodge defines nature study as "learning those things in nature that are best worth knowing, to the end of doing those things that make life most worth living." The purpose of nature study is to inculcate a love and an appreciation for the beautiful and wonderful in nature and to train the mind to acuteness in observation. Few things fulfill the requirements of these definitions so well or contribute so fully to the accomplishment of these aims as does the forest. In the forest can be found a wealth of material; it is one of the most sublime and useful of nature's institutions; it is replete with myriad forms of vegetable and animal life; the forest itself, as a whole, is living and active; it is full of the wonderful and the beautiful; it is teeming with interest at every season of the year; and it is accessible to almost everyone. The forest offers almost unlimited opportunity for botanical study, and the tree holds the advantage over other plants in that it is never out of season and can sustain the child's interest for an indefinite time.

While the individual trees furnish excellent material for study, it is the forest as a whole, with its vital influences on the life and well-being of mankind, its effects upon the water, the soil, the rain and the snowfall and the winds, and upon the various forms of animal life—in short, it is the relation which the forest bears to all else in nature that should prove especially attractive to the nature-study teacher and the source of greatest delight and most useful knowledge. To interest the child in the forest is an easy task. The mystery and strength of the woods have always appealed most strongly to the

child, and among the cherished tales in children's literature are the stories of the forests and their inhabitants.

The outline which follows is for the most part a compilation of the successful experience of successful nature-study teachers. The practical lines along which it has been evolved should merit for it a wide application. It is not proposed that the entire outline should be introduced by any one school, but that suitable portions of it be adapted to the needs and conditions of each school and utilized as part of the regular nature-study course. Field excursions and actual work among the trees are of far greater value than mere class-room exercises and add much pleasure and healthfulness to the study. Trips to the woods should be made in winter as well as during other seasons. It is in winter, when the trees are stripped of their foliage, that the forest best imparts its secrets.

Particular stress should be laid upon school nurseries and plantations. It is through these that the most practical lessons can be learned and permanent interest awakened. Planting trees on Arbor Day, or on any other day, is likely to do more harm than good unless the planting is properly done and the trees taken proper care of thereafter. In the school nursery the requisite knowledge and interest can be gained. Gathering and planting seeds, tending the little seedlings, establishing and caring for the plantation, and seeing it thrive under proper management, must serve as valuable object lessons which will leave their impressions through life. The problem of having the gardens cared for during the months of vacation can be met by the formation of a volunteer club from among the children for that purpose. Many schools have found that the plan works well with school gardens, and it should be equally successful with tree work.

The Forest Service of the Department of Agriculture will gladly furnish, without cost, outlines of a plan for school nurseries and plantations, and publications for use as text-books. Photographs may also be found very useful in the work suggested, and these can be supplied at small cost.

NATURE STUDY.

FIRST GRADE.

Fall Term.

Have the children bring in autumn leaves and mount them on cardboard. Teach them to distinguish a few common trees of the neighborhood by their leaves. Have simple drawings of leaves made or have leaves cut out of paper.

Winter Term.

Simple lessons on the usefulness of trees in nature; for example, they furnish homes for birds, animals, and man. The tree as a living thing, and as a good friend. Shapes of trees in sight from the school-room windows. Songs and stories of trees.

Spring Term.

General lesson on the effect of spring in the life of the tree. Observe in what order trees of the neighborhood put forth their foliage. Draw and paint pictures of leaves. Sow seeds in soil and on water, observing carefully the various stages of germination and growth.

SECOND GRADE.

Fall Term.

Have the children bring in seed pods, nuts, cones, etc., and mount good specimens. Trace, draw, or paint them. Show how trees are preparing for winter by dropping their leaves and covering their buds.

Winter Term.

Call attention to winter buds. Place twig, of maple if possible, in water and observe development of buds. The woods in winter. Stories. Pictures of woods in winter (snow scenes), lumber camps, sleds, sugar making, trapping.

Spring Term.

Development of winter buds, the coming of blossoms, catkins, leaves, etc. Have maple twigs brought to school. Tell how spring causes sap to flow in the tree. Place a twig in colored water and after a day or two split it and observe how the colored liquid has risen and in what part of the wood.

THIRD GRADE.

Fall Term.

Have the children bring in as many kinds of tree leaves as possible, and make simple classification by shape, margin, and veining. Study and paint a few specimens of leaves, fruit, and seed pods. Distinguish as many hardwoods as possible by leaves, nuts, seed pods, etc. Seed production and distribution.

Winter Term.

Take up the study of evergreens; pines, cedars, holly, live oak. Have twigs and cones brought to school. Observe cones and their structure. Stories of the pine tree, the Christmas tree, the fir tree, etc. Tell that evergreens are always covered with foliage. The needles remain on the tree for two years or more, while new leaves appear every spring. (Silvical Leaflets 1 to 24, 26 to 37, and 39. Forest Planting Leaflets 57, 60, 65, 67, 68, 70, 72, and 73, Forest Service.)

Spring Term.

Study of leaf structure. Study of tree, flower, foliage, and fruit, from a botanical standpoint. Plant some willow cuttings in wet sand and see whether they will develop roots. Place twigs of different trees in jars of water and watch results. (Forest Service Circular 96.)

FOURTH GRADE.

Fall Term.

Study the life of an individual tree in its most elementary aspect from the seed to its final use by man; its struggle for life against birds, insects, rabbits, frost; as a baby tree; as a mother tree; birds making their nests in its boughs. How a tree heals its wounds. Stories about trees. (Farmers' Bulletin 173 and Farmers' Bulletin 134, pp. 26-31.)

Winter Term.

Take up a further study of evergreens. Have drawings made of cones and winged seeds. Study arrangement of needles, leaves, or scales on the twig. Draw blackboard studies of evergreens. Show the characteristics of foliage and cones of different species. (See third grade, winter term.)

Spring Term.

Draw and color pictures of blossoms. Take trips into the woods; study the ground under the trees and note the structure of this forest floor; the thick canopy of leaves above; the long, clean trunks; how closely together the branches grow; how dark and cool it is in the forest. The forest as a whole. Begin to list time when seed of each species is ripened. (Farmers' Bulletin 173, Farmers' Bulletin 134, pp. 24-26, and Farmers' Bulletin 358, pp. 35-37. Year-book Separate 329.)

FIFTH GRADE.

Fall Term.

Begin study of the life of the tree. First the three parts—crown, trunk, and roots. Show the picture of the whole tree, of the root system, of the trunk. Observe the roots of an upturned tree in the neighborhood, if possible, or note root growth exposed by the cutting away of an embankment. Explain the office performed by each part in collecting, digesting, distributing, and assimilating food, and in other functions of the tree's life. Tell how sap ceases to flow as winter approaches, and its effect on the foliage and growth of the tree. Reproduction; how pollen is distributed. Cut seeds open and examine their structure. Continue listing time of seed ripening. (Farmer's Bulletins 173 and 134, pp. 21-31.)

Winter Term.

The structure and growth of the tree. The annual rings of growth. The inactive, strong heartwood; the weaker, active sapwood. The inner and outer bark and their functions in the life of the tree. Food ascends in sapwood, is digested in the leaves, and descends on the inner side of the inner bark. The medullary rays and their use. Show pictures of cross-sections of trees and, if possible, cross-sections of the trees themselves. Explain "grain" of different woods. Show Hough's "American Woods." Take these subjects up in connection with woodworking. Start the class keeping records of when the different trees perform their various life functions; in late winter record when the buds begin to swell. These observations should be kept up for an entire year. Apply to the U. S. Forest Service, Washington, D. C., for instructions and blanks for recording these phenological observations. (Farmers' Bulletin 173.)

Spring Term.

How the tree breathes. Transpiration: Invert a glass, as a bell jar, over an active plant; the moisture will condense on the glass. Trees in bloom. Observe them in yards, on streets, in parks and woods. Study flowers of the willows, horse chestnut, black locust, linden, maple, common hazel, cottonwood. Fertilization; reproduction; reproduction by sprouts. Record the time of bursting of buds, of blossoming, leafing out, ripening of fruit, etc., and recommend that the work be continued after school has closed for the summer. (Farmers' Bulletin 173. Forest Service Circular 96.)

SIXTH GRADE.

Fall Term.

Resume observing time of performance of functions of tree life and collect data recorded by pupils during vacation. Record time of ripening and falling of seeds, change in color of leaves, etc. Growth and distribution of seed. Have a collection made of seeds of the various trees in the locality, and placed in cabinet. (Forest Service Bulletin 29.)

Winter Term.

The tree in winter. Box elder and scarlet oak in their winter condition; pines and pine forests; pine forests and forests of deciduous trees compared. Take class into the woods; winter is an ideal time for seeing things in the forest.

Winter and Spring Term.

The tree in the forest. Show the tree in its relation to other trees. The struggle for existence. Why forest trees are tall, straight, and with limbless trunks. Decaying trees. Fungi. Observe the forest as a whole during winter and spring. The life of the forest. (Farmers' Bulletin 134, pp. 21-31, and Farmers' Bulletin 173.)

SEVENTH GRADE.

Fall Term.

Succession of forest trees. Pure and mixed forests. Conifers in sandy soils and on high altitudes. Deciduous trees demand better soils and more protected situations. Trees of the tropics. (Farmers' Bulletins 173 and 358.)

Winter Term.

Study different kinds of wood and their uses and ranges. Collect specimens of woods and prepare cabinets. If possible obtain specimens, about 6 inches by 2 inches, one side showing quartered or radial section, another tangential section, and the ends cross-sections. Have each specimen labeled with common name, and statement of its commercial importance and uses, and of its range. These subjects should be taken up in connection with woodworking or commercial industries.

Spring Term.

Effect of forests upon climate, temperature, changes of temperature, humidity, rainfall. Forest as windbreaks. (Farmers' Bulletin 358, pp. 29-36. Forest Service Circular 138.)

EIGHTH GRADE.

Effect of forest on fallen rain and snow: Retards evaporation and melting; decreases surface run-off; thick vegetable humus of the forest floor absorbs and holds water as a reservoir, and allows it to seep slowly into springs and streams; forest tends to prevent and decrease floods, and to make stream-flow regular. Forest takes up carbon dioxide; gives off oxygen; transpires water; fixes shifting sands. Tree roots hold soil in place and prevent erosion on slopes. Illustrate by photographs. Visit eroded fields and hillsides in neighborhood. (Farmers' Bulletin 134, p. 27; Farmers' Bulletin 358; Forest Service Circular 96.)

APPENDIX.

REFERENCES.

Application for publications of the United States Department of Agriculture named in this list, except those with a price affixed, may be made to the Department of Agriculture, Washington, D. C. Those with a price affixed can be obtained only by purchase. Remittance should be made by postal money order (stamps not accepted) directly to the *Superintendent of Documents, Government Printing Office, Washington, D. C.* Order by title and number.

For publications not issued by the Department of Agriculture application should be made to the publishers.

In some cases the references are only of local importance, and so may not be of value to teachers residing outside of the regions to which the publications refer.

FARMERS' BULLETINS.

- No. 134. Tree Planting on Rural School Grounds.
- No. 173. A Primer of Forestry. Part I.
- No. 228. Forest Planting and Farm Management.
- No. 358. A Primer of Forestry. Part II.

FOREST SERVICE CIRCULARS.

- No. 26. Forest Fires in the Adirondacks in 1903.
- No. 35. Forest Preservation and National Prosperity.
- No. 37. Forest Planting in the Sand-Hill Region of Nebraska.
- No. 41. Forest Planting on Coal Lands in Western Pennsylvania.
- No. 45. Forest Planting in Eastern Nebraska.
- No. 81. Forest Planting in Illinois.
- No. 96. Arbor Day.
- No. 99. Suggestions for Forest Planting on the Semi-Arid Plains.
- No. 100. Suggestions for Forest Planting in the Northeastern and Lake States.
- No. 105. White Oak in the Southern Appalachians.
- No. 109. Forest Planting in the North Platte and South Platte Valleys.
- No. 135. Chestnut Oak in the Southern Appalachians.
- No. 139. A Primer of Wood Preservation.
- No. 140. What Forestry has Done.
- No. 145. Forest Planting on the Northern Prairies.
- No. 150. Douglas Fir.
- No. 154. Native and Planted Timber of Iowa.
- No. 157. A Primer of Conservation.
- No. 161. Forest Planting in Western Kansas.

FOREST PLANTING LEAFLETS.

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| No. 54. How to Cultivate and Care for Forest Plantations on the Semi-Arid Plains. | No. 72. Western Yellow Pine. |
| No. 55. How to Pack and Ship Young Forest Trees. | No. 73. Red Cedar. |
| No. 56. Bur Oak. | No. 74. Honey Locust. |
| No. 57. Jack Pine. | No. 75. Hackberry. |
| No. 58. Red Oak. | No. 76. Silver Maple. |
| No. 59. Eucalyptus. (Revised edition.) | No. 77. Cottonwood. |
| No. 60. Red Pine. | No. 82. Hardy Catalpa. |
| No. 61. How to Transplant Forest Trees. | No. 83. Russian Mulberry. (Revised edition.) |
| No. 62. Shagbark Hickory. | No. 84. White Ash. |
| No. 63. Basswood. | No. 85. Slippery Elm. |
| No. 64. Black Locust. (Revised edition.) | No. 86. Boxelder. |
| No. 65. Norway Spruce. | No. 87. White Willow. |
| No. 66. White Elm. | No. 88. Black Walnut. |
| No. 67. White Pine. | No. 89. Tamarack. |
| No. 68. Scotch Pine. | No. 90. Osage Orange. |
| No. 69. Fence-Post Trees. | No. 91. Coffeetree. |
| No. 70. European Larch. | No. 92. Green Ash. |
| No. 71. Chestnut. | No. 93. Yellow Poplar. |
| | No. 94. Black Cherry. |
| | No. 95. Sugar Maple. |
| | No. 106. White Oak. |

FOREST SERVICE BULLETINS.

- No. 13. The Timber Pines of the Southern United States. (Price 35 cents.)
 No. 17. A Check List of the Forest Trees of the United States. (Price 15 cents.)
 No. 28. A Short Account of the Big Trees of California. (Price 15 cents.)
 No. 45. The Planting of White Pine in New England. (Price 20 cents.)
 No. 47. Forest Resources of Texas. (Price 15 cents.)
 No. 48. The Forests of the Hawaiian Islands. (Price 10 cents.)
 No. 63. The National Replacement of White Pine on Old Fields in New England. (Price 10 cents.)
 No. 65. Advice for Forest Planters in Oklahoma and Adjacent Regions. (Price 5 cents.)

SEPARATES FROM THE YEARBOOK OF THE DEPARTMENT OF AGRICULTURE.

- No. 212. Forest Extension in the Middle West. (1900.)
 No. 329. The Relation of Forests to Stream Flow. (1903.)
 No. 376. How to Grow Young Trees for Forest Planting. (1905.)

BOOKLET, NOT NUMBERED.

The Use of the National Forests.

PUBLICATIONS NOT ISSUED BY THE DEPARTMENT OF AGRICULTURE.

- Apgar, Trees of the Northern United States. New York.
 Brisbin, Trees and Tree Planting. New York.
 Dyson, Stories of the Trees. New York.

- Flagg, Year Among Trees. Boston.
- Hodge, Nature Study and Life, Chapters XXII and XXIII. Boston.
- Holden, Real Things in Nature. New York.
- Hough, The American Woods. Lowville, N. Y.
- Hough, Handbook of the Trees of the Northern United States and Canada. Lowville, N. Y.
- Huntington, Study of the Trees in Winter. Boston.
- Jackman, Nature Study for Grammar Grades. Chapters VII, VIII, and XXXI. New York.
- Keeler, Our Native Trees. New York.
- Lazenby, The Economic Uses of Wood. Columbus, Ohio.
- Lounsberry, Guide to the Trees. New York.
- Matthews, Familiar Trees and Their Leaves. New York.
- Macfarland, Getting Acquainted With the Trees. New York.
- Mosher, Fruit and Nut Trees. Syracuse, N. Y.
- Mosher, Our Cone-Bearing Trees. Syracuse, N. Y.
- Mosher, Oaks and Maples. Syracuse, N. Y.
- Overton and Hill, Nature Study. Chapters XIII, XVIII, XIX, XX, XXV, and XXVII. New York.
- Rodgers, The Tree Book. New York.
- Rodgers, Among Green Trees. Chicago.
- Roth, A First Book of Forestry. Boston.
- Sargent, Manual of Trees of North America. New York.
- Schenck, Forest Utilization. Biltmore, N. C.
- Schwappach, Forestry. London.
- Schwarz, Forest Trees and Forest Scenery. New York.
- Snow, Principal Species of Wood. New York.
- Stokes, Ten Common Trees. New York.
- Stone and Fickett, Trees in Prose and Poetry. Boston.

